Water Quality Monitoring Metadata (200704)

Identification_Information:
Citation:
Citation_Information:
Originator: National Oceanic and Atmospheric Association (NOAA) / National Ocean Service (NOS) / National Centers for Coastal Ocean Science (NCCOS) / Center for Coastal Ocean Science (CCMA) / Biogeography Team
Publication_Date: 200305
Title: La Parguera, Puerto Rico Water Quality Monitoring Data 2003 - Present
Publication_Information:
Publication_Place: Silver Spring, MD
Publisher: NOAA's Ocean Service, National Centers for Coastal Ocean Science (NCCOS)
Online_Linkage: http://www8.nos.noaa.gov/biogeo_public/water_quality_query.aspx
Description:
Abstract: These water quality data are one of many studies being done to assess and monitor coral reef ecosystems.

The intent of this work is three fold: (1) to spatially characterize and monitor the distribution, abundance, and size of both reef fishes and mega-invertebrates (conch, lobster, Diadema); (2) to relate this information to in-situ data collected on water quality and associated habitat parameters; (3) to use this information to establish the knowledge base necessary for enacting management decisions in a spatial setting and to establish the efficacy of those management decisions. Toward this end, the Center for Coastal Monitoring and Assessment's Biogeography Team (BT) has completed its fourth year and is beginning its fifth year of work in the US Virgin Islands and Puerto Rico. It is critical, with recent changes in management at both locations (e.g. implementation of MPAs) as well as proposed changes (e.g. zoning to manage multiple human uses) that action is taken now to accurately describe and characterize the fish / macro-invertebrate populations in these areas. It is also important that BT work closely with the individuals responsible for recommending and implementing these management strategies. Recognizing this, BT has been collaborating with partners at the University of Puerto Rico, National Park Service, US Geological Survey and the Virgin Islands Department of Planning and Natural Resources.

To quantify patterns of spatial distribution and make meaningful interpretations, we must first have knowledge of the underlying variables determining species distribution. The basis for this work therefore, is the nearshore benthic habitats maps (less than 100 ft depth) created by NOAA's Biogeography Program in 2001 and NOS' bathymetry models. Using ArcView GIS software, the digitized habitat maps are stratified to select sampling stations. Sites are randomly selected within these strata to ensure coverage of the entire study region and not just a particular reef or seagrass area. At each site, fish, macro-invertebrates, and associated water quality and habitat information is then quantified following standardized protocols. By relating the data collected in the field back to the habitat maps and bathymetric models, BT is able to model and map species level and community level information. These protocols are standardized throughout the US Caribbean to enable quantification and comparison of reef fish abundance and distribution trends between locations. Armed with the knowledge of where "hot spots" of species richness and diversity are likely to occur in the seascape, the BT is in a unique position to answer questions about the efficacy of marine zoning strategies (e.g. placement of no fishing, anchoring, or snorkeling locations), and what locations are most suitable for establishing MPAs. Knowledge of the current status of fish / macro-invertebrate communities coupled with longer term monitoring will enable evaluation of management efficacy, thus it is essential to future management actions.
Purpose: 1) To spatially characterize and monitor the distribution, abundance, and size of both reef fishes and macro-invertebrates (conch, lobster, Diadema); 2) To relate this

information to in-situ data collected on water quality and associated habitat parameters; 3) To use this information to establish the knowledge base necessary for enacting management decisions in a spatial setting; 4) To establish the efficacy of those management decisions; and 5) To work with the National Coral Reef Monitoring Program to develop data collection standards and easily implemented methodologies for transference to other agencies and to work toward standardizing data collection throughout the US states and territories.
Supplemental_Information: This work is being conducted in collaboration with the University of Puerto Rico, National Park Service, US Geological Survey, and the Virgin Islands Department of Planning and Natural Resources.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 200305
Ending_Date: Present
Currentness_Reference: Ground Condition
Status:
Progress: In Work
Maintenance_and_Update_Frequency: twice per year
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Place_Keyword: COUNTRY/TERRITORY > United States of America > Puerto Rico > La Parguera > La Parguera (17N067W0002)
Access_Constraints: None
Use_Constraints: Please reference NOAA/NCCOS/CCMA/Biogeography Team when utilizing this data in a report or peer reviewed publication. Additionally, knowledge of how this dataset has been of use and which organizations are utilizing it is of great benefit for ensuring this information continues to meet the needs of the management and research communities. Therefore, it is requested but not mandatory, that any user of this data supply this information to the Program Manager: Chris Caldow (email: chris.caldow@noaa.gov).
Point_of_Contact:
Contact_Information:
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Contact_Organization: NOAA/NCCOS/CCMA/Biogeography Team
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Address_Type: Mailing and Physical Address
Address: 1305 East-West Hwy. (SSMC4, N/SCI-1)
City: Silver Spring
State_or_Province: MD
Postal_Code: 20910
Country: USA
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Contact_Electronic_Mail_Address: chris.caldow@noaa.gov
Hours_of_Service: 9:00 - 5:00
Data_Set_Credit: This is a cooperative effort between NOAA's Biogeography Team and the University of Puerto Rico
Data_Quality_Information:
Logical_Consistency_Report: Not applicable
Completeness_Report: This data consists of multiple water quality measurements across all nearshore marine habitats around La Parguera Puerto Rico. Sites were randomly selected and stratified by habitat types using NOAA's benthic habitat maps of Puerto Rico.
Lineage:
Process_Step:
Process_Description: Site selection begins by stratifying NOAA's nearshore benthic habitat maps into predetermined habitat strata. Utilizing ArcGIS, sites are then randomly selected within strata throughout the region. Using a handheld GPS unit, the boat captain navigates to previously selected sites. A weighted buoy is dropped to mark any site where "live boating" is necessary.

Prior to diver deployment, in-situ water quality measurements are taken. Using the Hydrolab Datasonde 4a, measurements are taken at the surface and as close to the bottom as possible. Water quality parameters include: depth (m), temperature (C), conductivity (mS/cm), turbidity (NTU), and chlorophyll a (mg/l).

Data caveats: Bottom water quality measurements may not indicate actual depth for a site. The cord for the hydrolab is only 25 m, thus water quality measurements for deep sites reflect measurements "near the bottom". Also, measurements may not be complete due to sensor malfunction or cable connection problems. Also, chlorophyll is measured to the nearest tenth.

Detailed Methods for Characterization and Monitoring of Coral Reef Ecosystems and Associated Biological Communities

There are four complementary components to our field methodology. The first is a 25m long belt transect used to quantify

fish species' size and abundance. This component is particularly effective for sampling multiple habitat types such as mangroves where the diver is able to swim adjacent to the prop roots, or reefs, where it enables the diver to see what is on the distal side of structures. Additionally, high visibility is not as essential as with the second component, a point-count.

The point-count methodology has historically been used in the Virgin Islands and Florida Keys for examination of reef fish communities. By continuing to make use of the same methodology it enables us to compare current data against historical record. Fish data collected from these two components can then be related back to large-scale habitat information to identify spatial patterns in community structure. The third component involves taking detailed habitat measurements along the belt transect. These measurements can later be correlated to the fish data in order to gain insight into small-scale fish-habitat relationships. Finally, the fourth component is measuring water quality parameters at each site.

I. Belt Transect Fish Census:

The belt transect diver obtains a random compass heading prior to entering the water and records the compass bearing (0-3600) on the data sheet. This compass heading should allow the diver to stay on the specific habitat type they are intending to census without crossing over into a neighboring habitat. On site, no attempt to avoid structural features within a habitat such as a pile of conch shells, a sand patch or a tire in a seagrass or sand area should be made as these features affect fish communities and are "real" features of the habitats. Visibility at each site must be sufficient to allow for identification of fish at a minimum of 2m away. Once reasonable visibility is ascertained, the diver attaches a tape measure to the substrate and allows it to roll out as progress is made along the chosen compass heading for a distance of 25m. The transect should take 15 minutes regardless of habitat type or number of animals present. This allows more mobile animals the opportunity to swim through the transect, and standardizes the samples collected to allow for comparisons. As the tape roles out at a relatively constant speed, the diver records all fish species to the lowest taxonomic level possible that come within 2m of either side of the transect. Each survey is 100m2 in area (25m length x 4m width). To decrease the total time spent writing, four letter codes are used that consist of the first two letters of the genus name followed by the first two letters of the species name. In the rare case that two species have the same four-letter code, letters are added to the species name until a difference occurs. If the fish can only be identified to the family or genus level then this is all that is recorded.

If not even the family can be identified then no entry is necessary. The number of individuals per species is tallied in 5cm size class increments up to 35cm using visual estimation of fork length. If an individual is greater than 35cm, then an estimate of the actual fork length is recorded. Although the habitat should not be altered in any manner by lifting or moving structure, the observer should record fish seen in holes, under ledges and in the water column. To identify, enumerate, or

locate new individuals a diver may move off the centerline of the transect as long as they stay within the 4m transect width
and do not look back along area already covered. The diver is allowed to look forward toward the end of the transect for the
distance left along the transect (i.e. if the diver is at meter 15, he can look 10 meters distant, but if he is at meter 23,
he can only look 2 meters ahead). In mangrove areas the diver swims close to the prop roots and looks as far into the mangroves
as possible, up to 2m and then out to the edge of the mangrove overhang such that the total area surveyed is still 100m2.
In this case, some of the survey may necessarily fall on seagrass habitat. This is allowed as the mangrove habitat is
defined as a transition zone habitat. As soon as the belt transect diver has passed the 5m mark, the point-count and habitat
divers begin their work

II. Point-count Fish Census: Bohnsack-Bannerot (1986)
The point-count diver records all fish species seen within a vertical cylinder of radius 7.5m that extends from the
substrate to the surface of the water. Using a random number of fin kicks and a randomly chosen compass heading the center
of the cylinder is positioned to the side or behind the tape rolled out by the belt-transect diver such that there is no
overlap between the two surveys. The point-count diver also makes no attempt to avoid features within a habitat (see above).
While staying at the center point of the cylinder the point-count diver slowly rotates in a circle. All species seen within
the cylinder during a 5 minute period are recorded using the 4 letter codes described above. After the 5 minutes are up, the
diver records the number and size (in 5cm size class increments) of individuals seen for each species identified. This is
done during one full rotation per species in order from the bottom of the list to the top. Only schools of fishes unlikely
to remain in the cylinder past the first 5 minutes are enumerated and measured during the initial time period. In the
instance where species observed in the initial period are no longer seen in the area the count and measurement are done by
memory. After completion of the point-count survey, the point-count diver and the belt transect diver conduct habitat
rugosity measurements (see below).

III. Habitat Composition Census:
The habitat diver follows the belt-transect diver and records data on small-scale benthic habitat composition and structure
along the 25m transect. The habitat diver places a 1m2 quadrat divided into 100 (10 x 10cm) smaller squares
(1 square equals 1 percent cover) at 5 separate positions. Each position is randomly chosen before entering the water such that there
is one random point within every 5m interval along the transect. Percent cover is obtained as if looking at the quadrat in a

Data are collected on the following:
1) Logistic information - (diver name, dive buddy, date, time of survey, site code, and meter numbers at which the quadrat is
placed).

2) Habitat structure - to characterize the benthic habitats of the dive site, the habitat diver first categorizes the habitat structure of the site (e.g., colonized hardbottom, spur and groove, patch reef, pavement). This is done based on the hierarchical classification used in the benthic habitat maps (Kendall et al. 2001). The habitat diver must identify the broader categories: unconsolidated sediment, sub-aquatic vegetation (SAV), colonized or uncolonized hardbottom and, if possible, also identify the more detailed subclasses. The habitat category to which a site is assigned should be made independently of the map so that in-situ data can be used for map validation.

3) Proximity of structure - on seagrass and sand sites, the habitat diver records the absence or presence of reef or hard structure within 3m of the belt transect. A score of zero (0) indicates that no reef or other hard structure is present; one (1) indicates that a reef or hard structure smaller than 4m2 is present; and (2) indicates that a reef or hard structure larger than 4m2 is present. The point-count diver also uses this scoring system to record the absence, presence, and proximity of reef or hard structures within their cylinder.

4) Shelter (fish refuge) characteristics - the number of holes smaller or greater than 15cm in the largest dimension. Hole-width or length is visually estimated. In rubble habitat with many holes (i.e. more than 40), haphazardly sub-sample the quadrat by counting the number of holes in three, 4cm squares (4 percent of the quadrat) and then extrapolating to the entire 1m quadrat. Holes do not have to be fully enclosed; rather this is an estimate of places where fish might find refuge, so a ledge can suffice.

5) Transect depth profile - the depth at each quadrat position. Depth is measured with a digital depth gauge to the nearest 1ft.

6) Abiotic footprint - defined as the percent cover (to the nearest 1 percent) of sand, rubble, hard bottom, fine sediments, and other non-living bottom types within a 1m2 quadrat. Rubble refers to rocks and coral fragments that are moveable; immovable rocks are considered hard bottom. The percent cover given as a part of the abiotic footprint should total 100 percent. In a seagrass area for example, despite the fact that seagrass may provide 50 percent cover the underlying substrate is 100 percent sand so this is what is recorded.

To estimate percent cover, the habitat diver first positions the quadrat at the chosen meter mark along the transect tape. If the meter mark is an odd number, then the quadrat is placed on left side of the tape; if even, it is placed on the right.

Centering [the quadrat] over the tape measure as was done previously is no longer an option. Next, the habitat diver lays the quadrat along the substrate (regardless of the slope) and estimates percent cover based on a two-dimensional (planar) view (e.g. if bottom is sloping, the quadrat is not held horizontally). Also, the diver should try to use the same planar view for all estimates of percent cover. The habitat diver then estimates, for each quadrat, the height (in centimeters) of the hardbottom from the substrate to get a sense of bottom relief. Note: Height is collected for all hardbottom substrates, excluding rubble; height is not collected for softbottom substrate.

7) Biotic footprint - defined as the percent cover (to the nearest 0.1 percent) of algae, seagrass, live corals, sponges, gorgonians,
and other biota within a 1m2 quadrat. The remaining cover is recorded as bare substrate to bring the total to 100 percent. Again,
the diver must use a planar view to estimate percent cover of the biota. Seagrasses and gorgonians should not be stacked upright.
For example, e.g., if a single seagrass blade crosses 10 squares, then total seagrass coverage should be the sum of the area
taken up by that blade in all 10 squares instead of the area covered if the blade was held upright. Species covering less
than 0.1 percent of the area are not recorded. Taxa are identified to the lowest level possible (seagrass-species, algae-genus,
sponge-sponge, stony coral-species, and gorgonians-morphological group).
When estimating percent cover, it is important to realize there is a balance between precision and time. For stony corals,
the approximate area covered by living coral tissue is recorded. Coral skeleton (without living tissue) is usually categorized
as turf algae or uncolonized substrate. Data on the condition of coral colonies are also recorded. When coral is noticeably
bleached, the percentage of bleached coral is estimated to the nearest 0.1 percent. Diseased/dead coral refers to coral skeleton
that has recently lost living tissue because of disease or damage, and has not yet been colonized by turf algae. Turf algae
include a mix of short (less than 1cm high) algae that colonizes dead coral substrate.
8) Maximum canopy height - for each soft biota type (e.g., gorgonians, seagrass, algae), structure is recorded to the nearest
10cm.
9) Rugosity - measured by placing a 6-m chain at two randomly selected positions along the 25m belt transect. The chain is
placed such that it follows the substrate's relief along the centerline of the belt transect. Two divers measure the
straight-line horizontal distance covered by the chain (Figure 2). The chain is placed on top of any hard substrate encountered,
but not on top of soft corals or sponges since we are measuring hard bottom rugosity. Data on rugosity are collected for reef
sites only. Rugosity measurements typically are made by the point-count and belt-transect divers while awaiting the completion
of other benthic habitat measurements by the habitat diver. Upon completion of the dive, the rugosity data is transferred from
the fish data sheet to the habitat data sheet by the habitat diver.
10) Abundance and maturity of queen conchs (Strombus gigas) - conch encountered within the 25m x 4m belt transect are enumerated.
The maturity of each conch is determined by the presence or absence of a flared lip and labeled mature or immature, respectively.
If conch abundance is counted by a fish diver, the data are then reported to habitat diver. The decision of who will collect
conch data should be made prior to entering the water.
11) Abundance of spiny lobsters (Panilaurus argus) - measured by counting the number of lobsters encountered within the 25m x 4m
belt transect. No measurements are taken. If lobster abundance is counted by a fish diver, the data is then reported to habitat
diver. The decision of who will collect lobster data should be made prior to entering the water.
12) Abundance of long-spined urchin (Diadema antillarium) - measured by counting the number of urchins encountered within the

25m x 4m belt transect. No measurements are taken. If urchin abundance is counted by a fish diver, the data is then reported to habitat diver. The decision of who will collect urchin data should be made prior to entering the water.

NOTE: If rugosity, conch, lobster, or urchin data is collected by a fish diver, data must be transferred to the habitat data sheet. The habitat diver is responsible for transfering the data to their data sheet, however, the fish diver should assist the habitat diver with this task by reporting the data once the dive concludes.

Rapid Habitat Assessment (RHA) - The modified habitat survey is utilized to characterize areas within and nearby the Virgin Islands Coral Reef National Monument (VICR) boundaries. The RHA survey has the advantage of reducing bottom time at greater depths (i.e., sites below 80 ft). Site selection begins by stratifying NOAA's nearshore benthic habitat maps into predetermined habitat strata and monument boundaries. ArcGIS is then employed to randomly select sites within the hardbottom strata inside and outside the VICR boundaries. Using a handheld GPS unit, the boat captain navigates to the previously selected sites. Once on site, the transect and point-count divers are deployed. The habitat measurements are collected by the point-count diver for the area within his/her cylinder and those measurements are assumed representative of the habitat along the transect.

The following information is recorded:

1) Dive logistics - name of the diver, station ID, date, and the start time of the survey.

2) Habitat structure - the dive site is categorized based on the hierarchical classifaction used to produce the benthic habitat maps.

3) Depth - minimum and maximum depth of the survey area, to provide an estimate of bottom slope.

4) Rugosity (low, medium, or high) - based on the height of the tallest hardbottom structure.

5) Abiotic footprint - an estimate of percent cover (within 10 percent) of hardbottom, sand, and rubble in the 15-m cylinder. The sum of percent cover in the abiotic footprint must total 100 percent.

6) Biotic footprint - an estimate of the percent cover (within 10 percent) and min/max height (within 10cm) of live coral, gorgonians, sponges, macro algae, and uncolonized substrate in the 15-m cylinder. The sum of percent cover (including uncolonized substrate) in the biotic footprint must total 100 percent.

Photography - the point count or habitat diver will take at least two photos in different directions at each site to maintain an anecdotal and permanent visual description of the sites that were sampled. It is important to maintain the cameras and housings before, after, and in between dives. Proper care and maintance is neccessary for all camera and camera housings.

IV. Water quality measurements

Measurements of water quality parameters at each site are taken with a HydroLab at 1 meter below the water's surface and at the bottom. The following parameters are measured: depth, temperature, conductivity, and turbidity.

Process_Date: 200305

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        Contact_Organization: NOAA/NCCOS/CCMA/Biogeography Team
      Contact_Position: Tropical Ecosystem Monitoring and Assessment Database Manager
      Contact_Address:
        Address_Type: Mailing and Physical Address
        Address: 1305 East-West Hwy. (SSMC4, N/SCI-1)
        City: Silver Spring
        State_or_Province: MD
        Postal_Code: 20910
        Country: USA
      Contact_Voice_Telephone: 301-713-3028
      Contact_Electronic_Mail_Address: tom.mcgrath@noaa.gov
      Hours_of_Service: 9:00 - 5:00
  Resource_Description: Downloadable data
  Distribution_Liability: These data were prepared by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference therein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. Any views and opinions expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof. Although all data have been used by NOAA, no warranty, expressed or implied, is made by NOAA as to the accuracy of the data and/or related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by NOAA in the use of these data or related materials.
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Fees: None
Ordering_Instructions: Please contact Chris Caldow (chris.caldow@noaa.gov)
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Metadata_Contact:
Contact_Information:
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Contact_Organization: NOAA/NCCOS/CCMA/Biogeography Team
Contact_Position: Tropical Ecosystem Monitoring and Assessment Project Manager
Contact_Address:
Address_Type: Mailing and Physical Address
Address: 1305 East-West Hwy. (SSMC4, N/SCI-1)
City: Silver Spring
State_or_Province: MD
Postal_Code: 20910
Country: USA
Contact_Voice_Telephone: 301-713-3028
Contact_Electronic_Mail_Address: chris.caldow@noaa.gov
Hours_of_Service: 9:00 - 5:00
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